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UTILIZATION OF LIGNOCELLULOSIC AND CELLULOSIC BIOSORBENTS IN COMPOSITION OF BUILDING MATERIALS

High pollution of water bodies with mineralized water and toxic substances requires the development of effective methods to reduce this impact. One of the priorities tasks in the sphere of environmental protection is to find effective and safe wastewater treatment technologies.

At present, there exist urgent problems of utilization of waste from the agro-industrial complex. One of the promising areas is the application of principles of so-called "green chemistry", namely the development of technological processes using renewable raw materials. The possibility of application of renewable raw materials in the production of materials and products for the improvement of the ecology and for the solution of the problems related to technogenic pollution of water objects by various toxicants, including heavy metal ions, radioactive elements, petroleum products an others is of particular interest. It is also important that when using "green" technology both in Ukraine and abroad, each region is able to choose its raw material base depending on the specifics of the agro-industrial complex [1–3].

From the economic point of view it is promising to use agro-industrial complex wastes as biosorbents. Chemical activation and modification of natural sorbent promoted the improvement indexes of water purification. One of the possible ways of utilization of spent biosorbents can be the application in the composition of building materials [4, 5].

According to State standard of Ukraine it is allowed to enter up to 5 wt. % of additives. Therefore, unmodified walnut shells was introduced into the cement of type I-500-D0, which contains no additives, in order to evaluate the effect of the shells on the properties of cement.

The influence of the lignocellulosic and cellulosic biosorbents on the properties of cement was studied. The adding of1% modified shells to cement leads to an increase in the normal density of the samples, as shown on Fig. 1.Cellulosic material has a greater impact on cement properties due to the fibrous structure and due to the presence of oxygen-containing groups on its surface, which can form additional hydrogen bonds with water molecules.

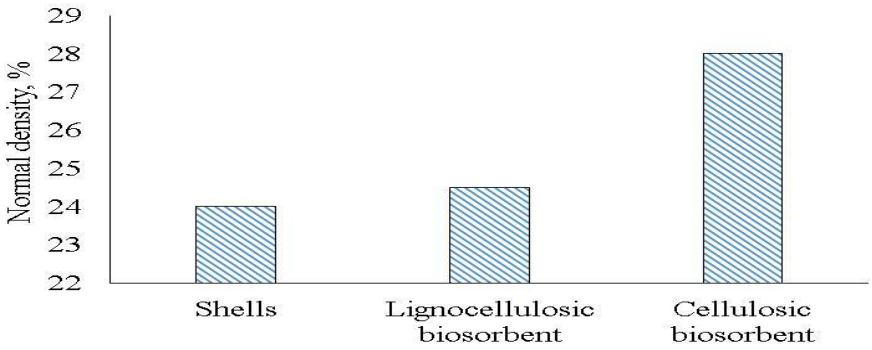

*Fig. 1.***Effect of lignocellulosic and cellulosic biosorbents on cement normal density**

Both biosorbents accelerate the time of hardening (Fig. 2), and these values are affected by the nature of the material. The higher the lignin content, the faster the hardening due to the presence of methoxy groups on its surface, which exhibit hydrophobicity. Cellulose sample has he longest period of hardening due to the ability to swell.

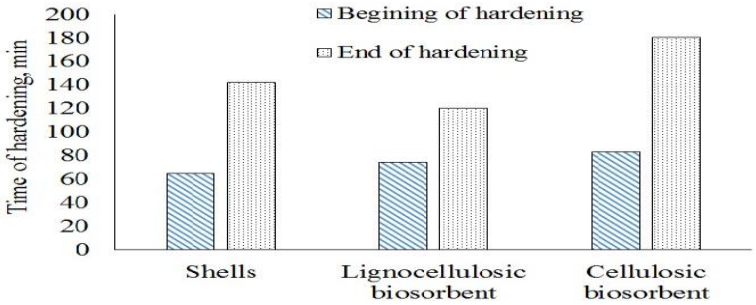

Fig. 2. **Effect of lignocellulosic and cellulosic biosorbents on cement hardening time**

The results of the investigation of the compressive strength of cement with the plant materials in its composition are given on Fig. 3.Cellulose in the composition of the modified shell contribute to the slowing of hardening, which is reflected in the strength of the cement samples at the age of 2 and 28 days. Adding of lignin-enriched biosorbentto cement composition does not lead to a significant deterioration of the mechanical properties of the test sample. Modified plant materials in the composition of the cement have different effects on the water removal coefficient (Fig. 4). Cellulosic biosorbent reduces the dehydration ability of cement.

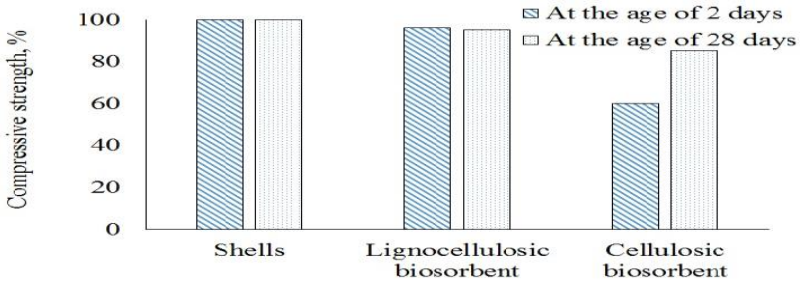

Fig. 3. **Effect of lignocellulosic and cellulosic biosorbents on cement compressive strength**

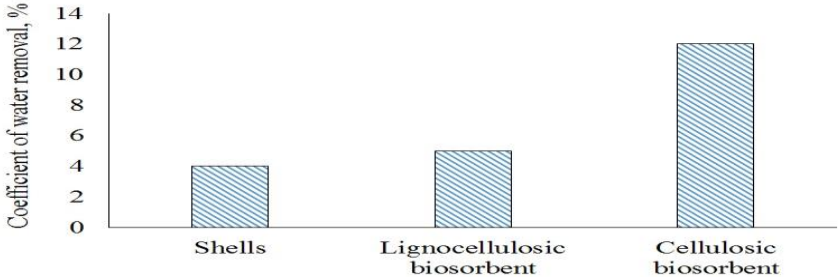

Fig. 4. **Effect of lignocellulosic and cellulosic biosorbents on coefficient of water removal from the cement**

Thus, lignocellulosic biosorbent cannot be recommended for use as a cement additivein an amount of more than 1%. However, it is worth noting cellulosic biosorbent has a negative effect on all cement properties.

The possibility of utilization of biosorbents in the composition of building materials was studied. Obtained results show limited ability to use modified walnut shells in the composition of cement. Studies have shown that enriched with lignin lignocellulosic biosorbent in the composition has a little effect on the physical and mechanical properties of the cement. The utilization of cellulosic biosorbents by the application as additives in production of cement cannot be recommended as the physical and mechanical properties reduce significantly.

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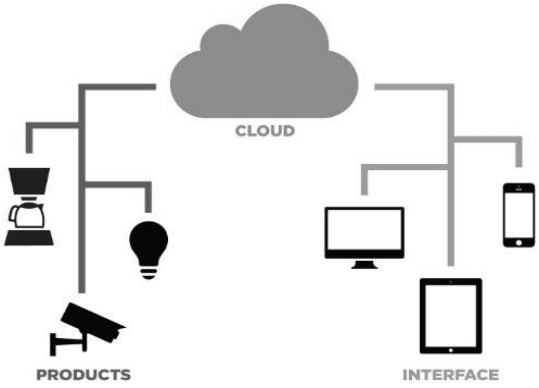
INTERNET OF THINGS

Have you ever had such that when leaving the house, you forgot to close the front door or turn off the light. Even if it was just a doubt, you still came back and checked it. But what if I say that there is a technology that allows you to avoid it.

Just few years ago, the Internet of things was an unknown and rather ridiculous expression, but today there are a lot of articles about it, now it is one of the main trends of information technologies. So, let's take a closer look.

The main purpose of Internet of things is to make your life easier and comfortable through simple interaction with surrounding objects. It means not only physical, but also voice and spiritual contact.



Picture 1. **Drawing representing the Internet of things (IoT).**

The concept was formulated in 1999 as an understanding of the prospects for the widespread use of radio frequency identification means for the interaction of physical objects with each other and with the external environment. Filling the concept of "Internet of things" a diverse technological approach and the introduction of practical solutions for its implementation since 2010 is considered a stable trend in information technology.

For the past three years this trend has been rapidly developing in the West countries and in Europe. Today, IoT startups are most financed projects in the whole world. Companies-giants have already invested a lot of money and attracted to the development the best specialists of the World. Also, it is very nice to take part in such startups because you are overwhelmed by the feeling that you create something that matters, that will change our lifestyle and, furthermore, our future. Thanks to such a project, you can already feel some of the charms that are expected in the future. Right now, many people do not have to worry about trifle, the Internet of things does it instead of them.

This technology will make our life more comfortable. It will control almost everything: the light in the house, air temperature, humidity, etc. I think it's very cool to listen to your favorite music, which had been set by your smart assistant, when you came home. And I am actually hope that in few years all of us will have the opportunity to try these features.